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Original Research Article

Necessity of fixation of fibula in distal tibia fractures

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ABSTRACT

Background: Distal tibia fractures and concomitant fibula fracture associated with soft tissue injury present as common orthopedic problems. This study evaluates the need to fix fibula fractures which are associated with closed distal third tibia fractures.
Methods: An interventional observational study was undertaken to analyse the efficacy of fixation of fibula, in a Tertiary care hospital with a sample size of 78 patients which were divided into 2 groups of 39 patients each- one in which fibula was fixed (A)-with nail (A1); with plate (A2) and one in which fibula was not fixed (B). Cases were followed up for a mean period of six months post-operatively.
Results: The comparison of functional outcome among both groups showed that combined group A (A1+A2) had 4 (10.25%) excellent functional outcome as compared to 1 in group B (2.56%). Group A shows better functional outcome as compared to group B with significant statistical difference. The mean duration of bone union in Group A1 was 21.26±1.43 weeks, A2 was 21.08±1.38 weeks and in group B was 23.60±2.47 weeks showing a statistically significant difference.
Conclusions: Fixation of fibula proved to facilitate ease of reduction of tibia and better rotational and angular stability with a superior ankle range of motion. The method of fixation of fibula did not seem to impact the outcome as long as the alignment, length, rotation were not compromised. Wound complications are not uncommon with precarious skin around the ankle, and should be managed appropriately.

Keywords: Distal tibia, Fibula fixation necessity, Fracture fibula

INTRODUCTION

Tibial fractures are seen in less than 7% fra tures overall and in less than 10% of all lower limb fractures, in which 15% of all distal tibia fractures are extraarticular. Males around 35-40 years of age are involved most commonly, as a result of motor vehicle accidents, fall from height, sports injury or trivial domestic falls.[1,2] Fractures are generally open type because the muscles and soft tissues covering are less in the lower leg. Thus, the complications of infection (16%), soft tissue damage, and delayed union (14%) are more common in distal tibia fractures.[3,4] The incidences of associated lower fibula fracture is also equally high (80%) and when it is associated, it is usually a result of high energy trauma and such fractures are very unstable.[5]

Fibula fixation as an adjunct method was proposed by Morrison et al to manage the fractures of the tibia and fibula.[16] In both clinical and laboratory settings, the role of fibular fracture fixation in cases of distal tibia-fibula fractures has been examined and it has been shown to help in maintaining the tibial fracture reduction.[7] Previously, studies have reported that effective plating of the fibula fracture improves alignment and the ability of the tibial fracture fixation to resist motion across the defect and prevents loss of reduction. On the other hand, fibular fixation may result in delayed union or nonunion because it inhibits the cyclic loading on the tibial fracture site.[8]

Lambert demonstrated that the fibula contributes to weight bearing function which carries one-sixth of the load applied across the knee joint. With ankle in neutral position, load distribution to the fibula has been shown to average between 6% and 7% of the total load transmitted through both the tibia and fibula.[10,11] The fibula has also been shown to contribute to the biomechanical stability of the ankle mortise during gait. When the ankle goes from plantarflexion to dorsiflexion, Close et al reported an increase in intermalleolar distance of 1.5 mm and lateral rotation of the fibular by 2.5°. This motion is in part due to the trochlear shape of the talar dome being wide anteriorly and narrows posteriorly. Scranton et al demonstrated that the fibula sinks approximately 2.4 mm across the mortise during stance phase of gait.[13] This deepening of the mortise during dorsiflexion of the ankle acts to create a close-pack stable position of the ankle in preparation for the toe-off phase of gait.

There seems to be a controversy about fibular fixation in the treatment of distal tibial fractures and data about the impact of fibular fixation in distal tibia-fibula fractures are limited. The major goal in the treatment of distal tibial fractures is achieving correct alignment, length and rotation for a stable union and functionally useful limb.

Therefore, the present observational interventional study was conducted to study the efficacy of fixation of fibula for accessing the radiological and functional outcome in fracture distal third tibia.

We hypothesised that fixation of fibula does not increase the stability of fixation in distal third tibia fractures.

METHODS

An interventional observational study was conducted in government medical college and hospital, Nagpur, India between October 2019 to December 2021 on a sample of 78 patients with distal tibia-fibula fractures.

Patients eligible for the study were those with combined distal tibia with concomitant fibula fracture at any level. Patients with injuries within 14 days of admission were included in the study.

Exclusion criteria were isolated tibia fractures, pathological fractures, open compound fractures, associated neurovascular injuries, associated compartment syndrome, previous malunion, non-ambulatory patient with neuromuscular disorder. A computer assisted randomization was performed into two groups of 39 each fulfilling inclusion and exclusion criteria. All the study patients for operative procedure were selected into two groups by stratified randomisation. After all subjects had been identified and assigned into blocks, simple randomisation was performed within each block to assign subjects to one of the groups. The data obtained was coded and entered into Microsoft Excel Worksheet. Data collected in the study was analysed using statistical package for the social sciences (SPSS) software for windows version 23. The categorical data was expressed as rates, ratios and proportions and comparison was done using chi- square test or Fisher's exact test. The continuous data was expressed as mean ± standard deviation (SD) and independent sample 't' test was used to compared the data. A probability value ('p' value) of less than or equal to 0.05 at 95% confidence interval was considered as statistically significant. The study was approved by the ethical committee of the institute. The selected subjects were visited and the questionnaire was administered after a written informed consent was obtained from the participants and all patients were willing to return to required postoperative follow-up visits.

Distal tibia fractures were fixed either with reamed intramedullary nailing or open reduction and internal fixation by plate or minimally invasive plate osteosynthesis, as dictated by the fracture configuration and morphology. In the first group, prior to fixation of tibia, fibula was fixed by 3.5 dynamic compression plate or one-third tubular plate through lateral approach or poster lateral approach as dictated by fracture pattern. The surgery was performed between first and 13th day from the time of injury. All procedures were performed under spinal or general anaesthesia.

Ankle and knee range of motion was allowed immediately for extra-articular fractures, was delayed for a mean period of two weeks in case of comminuted articular fractures. Partial weight bearing was allowed after a period of three months which was progressed to full weight bearing as tolerated. Follow-up radiographs were taken at 4, 8 and 12 weeks after surgery, followed by every six months till radiologic and clinical signs of healing were seen. All the results were analysed and malunion, non-union and infections were recorded; expressed as mean ± standard deviation, frequency and percentage. An independent examiner performed all measurements to the eliminate bias. Ankle function was assessed by American orthopaedic foot and ankle score (AOFAS). Radiologic rate of union was assessed by Johner and Wruh criteria. Angulations in the coronal plane (varus-valgus) and coronal plane (procurvatum-recurvatum) were measured on antero-posterior and lateral projections of the tibia respectively by evaluating the angle formed between the perpendicular lines drawn from tibial plateau and tibial plafond.[28] Malrotation was assessed clinically wherein the mechanical axis of tibia passed from the centre of patella to center of ankle joint using a plumbline. Non-union was defined as absence of radiologic progression of union and existence of pain at fracture site until six months. Bony union was considered when the patient was able to bear weight without pain at the fracture and radiologic callus formation at fracture site.

RESULTS

We enrolled 78 patients in this study who were eligible. In each group there are 39 patients each with group A further

subdivided into A1- fibula fixed with nail with 14 cases and group A2 with fibula fixed with plate with 25 cases.

Details about demographic and injury characteristics are tabulated in Table 1.

Table 1: Demographic characteristics, classification and type of fracture.

Variables	Group A	Group B
Number	39	39
Age (years)	36±12.01	35±15.23
Sex	Male 29/ female 11	Male 30/ female 09
Mechanism of injury		
Road traffic accidents	28	30
Trauma	09	08
Others	02	01
Side	Right 21/Left 18	Right 22/Left 17
OTA		
A	09	10
B	19	20
C	11	09

Table 2: Clinical and radiographic outcomes of study.

Variables	Group A1, (n=14)	Group A2, (n=25)	Group B, (n=39)	P value
Duration for bone union in weeks	21.26±1.43	21.08±1.38	23.60±2.47	0.04
Operative time in minutes	72.26±6.39	74.52±6.22	68.46±4.31	0.07
Intraoperative complications	01	01	01	0.91
Postoperative complications	01	02	05	0.03
Functional outcome by AOFAS				
Excellent	01	03	01	0.03
Good	10	18	24	
Accepatble	02	04	12	
Poor	01	00	02	
Outcome by Johner and Wruh criteria				
Excellent	01	03	01	0.03
Good	10	16	14	
Fair	03	06	2	
Poor	00	00	01	

Figure 1: Postoperative radiograph of showing malalignment in both coronal and sagittal plane in group B.

Figure 2: Clinical photograph showing wound complication in form of wound maceration on post operative day 13.

Four cases in group B went into non union with the mean duration of union being lesser in group A than group B with statistical difference ($p<0.05$). The method of fixation of fibula- plating or nailing, did not seem to affect the rates of union. One patient in group A1 was found to have valgus malalignment and five patients in group B were found to have malalignment in both sagittal and coronal planes. Valgus tibial malalignment was found to be more common in group B with a statistically significant difference ($p<0.05$). The two patients in group A2 (fibula fixed with plating) developed superficial wound infection which was managed with intravenous antibiotics along with local debridement and irrigation. Patients with malalignment on immediate post operative (1 in group A1 and 7 in group B) underwent corrective surgeries within two weeks of index surgery with favourable outcome. Nineteen cases out of 39 underwent dynamization of tibia nailing.

The functional outcome was assessed by AOFAS among both groups. Group A (A1 +A2) shows better functional outcome as compared to Group B with statistical significant difference ($p<0.05$). Clinical and radiologic outcome as assessed by Johner and Wruh criteria- it was observed group A (A1+A2) shows better outcome with respect to Johner and Wruhs' criteria compared to Group B with statistically significant difference ($p<0.05$).

DISCUSSION

The present study is a prospective observational study undertaken to analyse the efficacy of fixation of fibula on the radiological and functional outcome of fracture distal third tibia. Both the groups were similar with respect to the demographic characteristics with no statistical difference in type or pattern of injury.

Prasad et al in a study observed patients treated with fixation of fibula had comparatively higher complications than those without.[14] In our study, two out of 39 patients treated with fixation of fibula developed superficial wound infections over the fibular wound site. All of them were controlled by appropriate debridement and intravenous antibiotics. There is usually significant soft tissue injury associated with distal lower limb fractures due to paucity of soft tissue envelope around the subcutaneously located tibia-fibula, which would in turn increase the risk of skin dehiscence and subsequent infection. In this study, there was no significant difference in the prevalence of infection as an adverse effect of fibula fixation.

A study by Teitz et al showed that sparing the fibula may result in rapid union of the fracture because of the inhibiting cyclic compression theory. According to them, fibula sparing resulted in rapid union of tibia considering an intact fibula is inhibits the cyclic compression of fracture site necessary for physiologic healing of fracture site.[15] There are some theories which advocate fibulectomy and fibular osteotomy in tibial nonunion. Varsalona and Lou concluded, in their study on distal tibia fractures, that the basis of using fibular fixation is not established when the fracture does not involve the syndesmosis or ankle mortise.[16] Improper reduction of fibula may be associated with higher rates of malunion at a later date with an additional soft tissue trauma of the surgery. Vallier et al prospective study of 104 43-A fractures, out of which 28 had associated fibular fractures (27%), were randomized to intra-medullary nailing vs. medial plating.[17] They found 4 patients (7.1%) with non union after nailing versus 2 (4.2%) after plating ($p=0.25$) with a trend for nonunion in patients who had fibula fixation (12% vs. 4.1%, $p=0.09$).

The 85% of patients with malalignment after nailing did not have fibula fixed. According to their data, fibula fixation aids in tibial reduction at the time of surgery, but ultimately contributes to nonunion. Our study, in contrast, had better union rates in cases of distal tibia fractures where fibula was fixed with no differences in clinical outcome when different method of fibula fixation were used.

Bonnevialle et al stated that fibula and tibia fractures should be considered as a single biomechanical and pathologic entity, and confirmed the value of double surgical osteosynthesis as a complement to stability and an aid to tibial reduction.[18] Kumar et al performed a study on cadavers with simulated tibia and fibular fractures and demonstrated that fibular osteosynthesis increased stability by decreasing axial rotation of tibial distal metaphysical fractures when torque was applied to tibial tubercle.[19] They concluded that fibular plate fixation increased rotation stability and decreased the risk of malunion with valgus deformity. In our study, there was an increased incidence of external rotation with valgus deformity in patients when fibula was not fixed.

But some studies have different results than our results and reported advantages or disadvantages of fibular fixation in the treatment outcomes. The difference among these results and our results could be explained by the difference in the design of the studies, the difference in surgery procedure and the duration of follow-up.

Limitations

The limitations of this study was the small number of samples during the follow-up period, personal experience bias of senior surgeons and may be less reflective of the procedure and sequence of the procedure itself. The tibia fibular stability was not assessed preoperatively but intraoperative hook test was performed elucidate translation of the fibula. Nevertheless, none of the post operative X-rays showed any tibifibular gap.

CONCLUSION

Fixation of fibula proved to facilitate ease of reduction of tibial fracture and better rotational and angular stability with a superior ankle range of motion. The method of fixation of fibula did not seem to impact the outcome as long as the alignment, length, rotation were not compromised. Wound complications are not uncommon

with precarious skin around the ankle, and should be managed appropriately.

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